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Abstract

STUDIES OF RESONANCE ABSORPTION AND THE DOPPLER PHENOMENON FOR FAST AND THERMAL REACTORS

by

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Part I of the paper describes some investigations of resonance absorption and its temperature dependence in dilute fast reactors. Two particular problems are discussed with special reference to the Doppler temperature coefficient:- the overlapping of resonances of the fissile and fertile constituents of the fuel, and the consequences of using multilevel resonance theory instead of the customary single level theory. A new numerical method for treating the resonance energy region of dilute fast reactors is then described. This method allows automatically for resonance overlapping and multilevel theory as well as for core heterogeneity, and enables the detailed neutron energy spectrum between 20 kev and thermal energies to be calculated. Some results from a preliminary test of the method for a homogeneous mixture of uranium 238 and carbon are compared with calculations using a conventional method.

Part II deals with the calculations of resonance integrals for heterogeneous thermal reactors. The use of equivalence theorems, which enable results for a homogeneous medium to be applied to a heterogeneous system, is explained. An improved form of the standard equivalence theorem for isolated solid fuel rods is derived. The application of equivalence theorems to treat regular arrays or finite clusters of fuel rods is discussed, introducing the concept of 'effective surface'. A method of calculating this parameter for liquid-filled arrays or clusters is outlined. Calculated values

of the resonance integral and its temperature dependence are then compared with experimental data on UO_2 rods and clusters, and also with results obtained by the Monte Carlo method.

An investigation is made of the resonance integral for fissile isotopes when mixed with uranium 238, with particular attention to the effect of resonance overlapping. Numerical results are compared with measurements of the relative reaction rates of fissile samples in uranium and copper bars, which were irradiated in a uranium-fuelled graphite lattice.